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Title:Soot Optical Properties in the Terahertz Spectra Domain
Authors:Fei Wang (1); Ting Xu (1); Zhishen Qiang (1); Qunxing Huang (1); Dong Liu (1); Jianhua Yan (1); Kefa Cen (1)
Author affiliation:(1) State Key Lab. of Clean Energy Utilization, Zhejiang Univ., Hangzhou, China
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Abstract:For understanding and accurately modeling combustion, the important questions are what species are present in the flame, and the spatial distribution and temperature of these species. Traditional optical methods used only the electromagnetic waves in the wavelength region from the ultraviolet region up to the infrared. Terahertz time-domain spectroscopy technique can be used for the combustion research as a novel tool. However, for some sooty combustion environments, the strong absorption, spectral interference from soot scattering, and fluorescence from large molecules must be considered. The optical properties of soot in the terahertz domain are the main basic data for terahertz application. In this paper, the terahertz time-domain spectroscopy technique was used to study the optical properties of flame soot within 0.2-1.6 THz. The complex refractive indices of the soot were deduced by the fixed-point iteration method. In order to validate the results, the complex refractive indices of the soot from the four different fuel flames were deduced. It was found that the complex refractive indices in the terahertz domain of the soot from the different fuel flames are very close to each other. The comparisons of complex refractive indices between the visible-IR domain and the terahertz domain indicate that the value of absorption index in terahertz domain is smaller than in IR domain, which implies that the terahertz wave will penetrate the sooty flame with smaller absorption than the IR rays. The results can provide the basic optical data of flame soot for the application of terahertz time-domain spectroscopy technique in the optical combustion diagnostics and extend the optical combustion diagnostics application area.
Number of references:21
Inspec controlled terms:combustion - flames - fluorescence - iterative methods - refractive index - soot - spectrochemical analysis - terahertz wave spectra
Uncontrolled terms:soot optical properties - terahertz spectra domain - combustion modeling - electromagnetic waves - ultraviolet region - infrared region - terahertz time-domain spectroscopy

technique - sooty combustion environments - soot scattering - fluorescence - terahertz domain - complex refractive index - fixed-point iteration method - fuel flames - visible-IR domain - absorption index - optical combustion diagnostics - frequency 0.2 THz to 1.6 THz

Inspec classification codes:A8280D Electromagnetic radiation spectrometry (chemical analysis) - A0260 Numerical approximation and analysis - A3320B Radiofrequency and microwave molecular spectra - A3350D Molecular fluorescence and phosphorescence spectra - A7820D Optical constants and parameters (condensed matter) - A7855 Photoluminescence (condensed matter) - A7870G Microwave and radiofrequency interactions with condensed matter - A8240P Flames, combustion, and explosions

Numerical data indexing:frequency 2.0E+11 1.6E+12 Hz

Treatment:Theoretical or Mathematical (THR); Experimental (EXP)

Discipline:Physics (A)

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